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Evaluation of Safety Culture Through Field Research in a Hydrocarbon Exploration and Exploitation Company

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This study examines safety culture in hydrocarbon facilities through empirical research involving 133 employees across various hierarchical levels and educational backgrounds. The research employed a structured questionnaire focusing on four key dimensions: communication, training, employee involvement, and prevention procedures. Statistical analysis revealed significant differences related to employee gender and educational level. Results indicate that perception of safety measure effectiveness varies across the workforce, influenced by social, educational, and professional factors. A key finding emphasizes the necessity for two-way communication on safety issues, as traditional one-way approaches prove insufficient for creating effective safety culture. Main recommendations include establishing effective two-way communication channels, developing practical training programs tailored to specific work environments, and enhancing employee participation in safety policy formulation.

Keywords: safety culture, hydrocarbon sector, field research, employee perception, communication, training, prevention procedures

1. Introduction

Ensuring health and safety in the workplace constitutes a fundamental prerequisite for the proper and sustainable operation of any organization, particularly in high-risk industries such as hydrocarbon extraction and processing (Reason, 1997; Hudson, 2007). In such environments, where technical requirements, physical hazards, and operational demands coexist within a framework of increased complexity, the existence of a strong safety culture is not merely desirable but absolutely necessary (Guldenmund, 2000; Antonsen, 2009).

The concept of safety culture refers to the set of shared values, attitudes, perceptions, and practices related to safety among members of an organization (IAEA, 1991; Schein, 2010; Guldenmund, 2000). As emphasized by the Health and Safety Executive (HSE), this culture determines "the way individuals perceive and act toward risks (Reason, 1997; Cooper, 2000), as well as their attitude toward accident prevention and protection of themselves and their colleagues."

In the Greek context, despite significant progress in prevention and standardization of safety procedures, research shows that inequalities persist regarding access to information, training, participation (Flin et al., 2000; Hudson, 2007) in institutional bodies, and the overall integration of safety into organizational culture. These variations are strongly influenced by factors such as work position, gender, experience, education, and hierarchical position.

Management may appear absolutely certain about the adequacy of procedures without having an accurate picture of daily implementation difficulties. Supervisors, as a link between management and the executive base, often adopt a more realistic and critical stance, while administrative staff or technical operators exhibit differentiated experiences depending on their participation in Health and Safety committees or their exposure to actual risks.

This study seeks to record and analyze the perceptions, experiences, and attitudes of employees in hydrocarbon facilities regarding workplace safety through a specialized structured questionnaire designed based on international tools such as the Safety Climate Questionnaire and the HSE model.

2. Theoretical Background

Safety culture constitutes a critical field in organizational risk management (Antonsen, 2009; Hudson, 2007), directly affecting employee behavior and workplace practices. The term first emerged after serious accidents such as the Chernobyl nuclear disaster in 1986 (IAEA, 1991), when it became apparent that human behaviors and organizational failures played a decisive role in creating the crisis.

Safety culture consists of a set of values, beliefs, and practices that determine people's attitude toward safety. Theoretically, it can be analyzed through three basic levels (Schein, 2010): (a) visible employee behavior, (b) values and standards guiding decisions, and (c) underlying beliefs that often remain unclear or unconscious.

The significance of safety culture lies in directly affecting the effectiveness of risk management systems (Cooper, 2000; Antonsen, 2009). In organizations with strong safety culture, employees feel responsible for the safety not only of themselves but also of their colleagues (Hudson, 2007; Reason, 1997). Furthermore, safety culture influences compliance with regulatory requirements and improves organizational reputation.

Safety culture is approached from different theoretical perspectives. "Safety climate" refers to employees' perceptions regarding practices, policies, and procedures implemented to promote safety (Zohar, 1980; Flin et al., 2000). Another approach is based on the "value system" theory, where safety culture is embedded in the deeper values and beliefs of the organization. The "multiple barriers model" supports that organizations can protect workers through creating multiple levels of defense, such as safety protocols, technological measures, and training programs (Reason, 1997).

Safety culture is influenced by organizational factors (structure, policies, leadership), technological factors (innovations, detection systems, automation), and human factors (individual attitudes, beliefs, perceptions shaped by education and experience) (Guldenmund, 2000; Hopkins, 2006).

3. Methodology

3.1 *Study Purpose and Objectives*

The purpose of this study is to investigate safety culture in hydrocarbon extraction and processing facilities, with particular emphasis on employees' perceptions, experiences, and attitudes toward health and safety issues. The study aims to identify differences in perceptions according to sociodemographic and professional characteristics and to identify critical areas for intervention.

3.2 *Research Hypotheses*

Previous research suggests that employees' perceptions of safety culture may vary according to demographic and organizational characteristics such as gender, education, hierarchical position and work experience (Flin et al., 2000; Antonsen, 2009; Hudson, 2007)

Based on relevant literature and industry practices, four hypotheses were tested:

- H1: Gender is expected to influence employees' perceptions of safety culture indicators.
- H2: Educational level is expected to influence employees' evaluation of safety management practices.
- H3: Professional position is expected to influence employees' perceptions of safety culture implementation.
- H4: Years of professional experience are expected to influence employees' confidence in organizational safety practices.

3.3 *Research Instruments*

The research tool is a structured questionnaire titled "Safety Culture Assessment Questionnaire," (Zohar, 1980; Flin et al., 2000) designed specifically for the hydrocarbon industry. Content validity was ensured through expert review by occupational health and safety specialists, while a pilot test was conducted to confirm the clarity and relevance of the questionnaire items before the full survey distribution

It was organized into three levels: (1) General Level for all employees with closed-answer questions on policy, communication, training, and procedures; (2) Intermediate Level for supervisors and technical staff using Likert scale questions on adequacy, effectiveness, and satisfaction; (3) Senior Level for executives assessing policy implementation and

organizational performance. The anonymous questionnaire was distributed electronically with average completion time of 10-15 minutes.

3.4 *Sample and Analysis*

The questionnaire was distributed electronically to all employees working in the selected operational units of the company. A total of 133 valid responses were collected, corresponding to a response rate of 91.72%, across different facility types (onshore: 90, offshore: 41, vessels/barges: 2), covering diverse roles, genders, educational levels, and experience ranges. Analysis employed descriptive statistics, chi-square tests for group comparisons, and qualitative analysis of open-ended responses (Patton, 2002). Table 1 presents detailed sample characteristics.

Characteristic	Category	%
Facility Type	Onshore facilities	67.67
	Offshore platforms	30.83
	Other (vessels, barges)	1.50
Position	Technician	57.14
	Supervisor/Manager	12.78
	Operator	12.03
	Administrative staff	7.52
	Executive	2.26
Education	University degree	52.63
	Postgraduate/Doctoral	23.31
	Technical education	15.04
	High school	9.02
Gender	Male	90.23
	Female	6.77
	Other/No answer	3.00
Years of Service	1-3 years	39.85
	>10 years	32.33
	4-6 years	12.03
	7-10 years	9.77
	<1 year	6.02

3.5 *Limitations*

This cross-sectional study relies on self-reported responses, potentially affecting objectivity. Voluntary participation may introduce self-selection bias. Sample imbalances exist regarding gender and facility type. The single-point-in-time data collection prevents assessment of safety culture evolution over time.

4. Results

4.1 *Overall safety culture assessment*

The study reveals a generally positive safety culture picture across the organization. Table 2 presents core safety culture indicators showing high acceptance of policies, procedures, and training programs. The results indicate a generally positive perception of safety culture across most indicators, particularly regarding the existence and implementation of safety policies and procedures (see table 2). However, critical gaps emerge in actual participation and maintenance effectiveness. While 97.7% acknowledge Health and Safety Committee existence and 64.7% state meetings occur with staff participation, only 31.6% personally participate. This reveals a significant disconnect between institutional structures and genuine employee engagement. Additionally, maintenance effectiveness shows the lowest satisfaction rate at 65.4%, with nearly 20% explicitly expressing dissatisfaction.

Table 2. Core Safety Culture Indicators - Overall Results

Safety Culture Dimension	Yes (%)	No (%)	Don't know (%)
Safety policy exists	97.0	1.5	1.5
Safety policy implemented	92.5	4.5	3.0
Management promotes safety culture	94.0	3.0	3.0
Safety procedures known	95.5	2.3	2.2
Safety procedures applied	98.5	0.8	0.7
Communication channels exist	94.7	3.0	2.3
Can report incidents without fear	91.7	4.5	3.8
Anonymous reporting available	97.0	1.5	1.5
Pre-employment safety training	97.7	0.8	1.5
Regular safety training	92.5	6.0	1.5
Emergency evacuation training	88.0	10.5	1.5

Safety Culture Dimension	Yes (%)	No (%)	Don't know (%)
Staff trained in equipment use	95.5	1.5	3.0
H&S Committee exists	97.7	0.8	1.5
Committee meetings held	64.7	15.8	19.5
Safety officer exists	96.2	2.3	1.5
Occupational physician exists	72.9	5.3	21.8
PPE provided	96.2	3.0	0.8
Frequent equipment inspections	88.7	3.8	7.5
Regular fire safety checks	94.7	3.0	2.3
Effective facility maintenance	65.4	19.5	15.1

4.2 *Gender differences*

Statistical analysis reveals highly significant gender-based differences in safety. Female employees show 20-30% lower confidence in safety measures and dramatically lower participation in safety committees (11.1% vs. 33.3% for males). This finding supports hypothesis H1 and indicates systemic barriers to female inclusion in safety processes, highlighting the need for targeted gender-inclusive initiatives (see table 3).

Table 3. Safety Perception by Gender - Key Differences

Variable	Male (%)	Female (%)	Statistical Significance
Safety policy exists	98.3	77.8	$p < 0.001$
Safety policy implemented	94.2	66.7	$p < 0.001$
Know safety procedures	97.5	66.7	$p < 0.001$
Can report without fear	94.2	66.7	$p < 0.001$
Effective maintenance	70.8	11.1	$p < 0.001$

Table 3 shows that female employees consistently report lower confidence across all safety dimensions compared to male counterparts

4.3 *Educational Level Differences*

Educational background significantly influences safety perception, supporting hypothesis H2. Employees with technical education demonstrate highest satisfaction and participation rates (95%+), while postgraduate degree holders show the most critical perspective, particularly regarding maintenance effectiveness (45.2%) and organizational changes (69.2%). This suggests that higher education brings increased expectations and more rigorous evaluation criteria for safety practices (see table 4).

Table 4. Safety Perception by Education Level - Key Findings

Variable	High School (%)	Technical (%)	University (%)	Postgraduate (%)
Safety policy exists	100	100	98.6	90.3
Effective maintenance	83.3	95.0	62.9	45.2
Satisfied with organizational changes	100	95.0	70.5	69.2

Table 4 reveals an interesting pattern where higher education correlates with more critical assessment of safety practices

4.4 *Position-Based patterns*

Hypothesis H3 was not statistically supported. Executives express highest confidence in safety systems, while supervisors—positioned between strategic planning and operational execution—demonstrate the most realistic and critical perspective. Administrative staff shows notably low assessment of maintenance effectiveness (20%), suggesting limited visibility or different experiences with facility conditions (see table 5).

Table 5. Safety Perception by Position - Hierarchical Patterns

Variable	Workers (%)	Technicians (%)	Supervisors (%)	Administrative (%)	Executives (%)
Safety policy exists	100	97.4	94.1	100	100

Variable	Workers (%)	Technicians (%)	Supervisors (%)	Administrative (%)	Executives (%)
Safety policy implemented	100	93.4	82.4	100	100
Effective maintenance	90.9	68.4	58.8	20.0	66.7
Management promotes safety	100	96.1	88.2	100	66.7

Table 5 reveals meaningful patterns in safety perception across hierarchical levels.

4.5 *Intermediate Level Assessment*

Emergency preparedness receives strongest endorsement (90.4% for emergency teams, 81.7% for emergency adequacy), while satisfaction with organizational changes shows lowest levels (74.1%), suggesting employees desire greater involvement in change processes (see table 6).

Table 6. Staff Adequacy and Procedures Assessment (% responding "Much" or "Very much")

Dimension	Positive Response (%)
Staff Adequacy	
During normal operation	80.7
During maintenance	70.2
In emergency situations	81.7
Emergency teams exist	90.4
Communication with emergency teams	78.9
Monitoring & Assessment	
Regular measurements of harmful factors	85.6
Evaluation of measurement results	80.7
Implementation	
Safety procedures applied daily	85.6
Staff informed/trained on risks	79.8
Organizational Changes	
Satisfaction with safety improvements	74.1

Table 6 presents staff adequacy and procedure implementation assessment using Likert scale responses, showing generally high confidence with specific areas requiring attention.

4.6 *Facility Type Comparison*

Offshore facilities demonstrate superior performance, particularly in maintenance effectiveness (90.2% vs. 53.3%), likely attributable to stricter maritime regulations and the critical nature of equipment reliability in isolated offshore environments. However, both facility types show similarly low committee participation, indicating organization-wide engagement challenges (see table 7).

Table 7. Offshore vs. Onshore Facilities Comparison

Variable	Offshore (%)	Onshore (%)	Key Difference
Safety policy implemented	100	88.9	Stricter offshore protocols
Participate in H&S Committee	34.1	28.9	Similar low participation
Effective maintenance	90.2	53.3	Major difference
Regular safety training	97.6	90.0	Higher offshore frequency
Workplace safe & organized	100	80.0	Better offshore conditions

Table 7 compares offshore and onshore facilities, revealing significant operational differences despite similar overall safety culture.

4.7 *Critical Gaps Summary*

The most critical gap involves committee participation: despite near-universal acknowledgment of institutional structures, actual

engagement remains very low. Gender disparity and maintenance concerns represent additional high-priority areas requiring immediate intervention (see table 8).

Table 8. Key Gaps in Safety Culture Implementation

Area	Current State	Gap Identified	Priority
H&S Committee Participation	31.6% personal participation	68.4% non-participation	High
Gender Inclusion	11.1% female participation	22.2% gap vs. male participation	High
Maintenance Effectiveness	65.4% satisfied	34.6% unsatisfied/uncertain	High
Two-way Communication	94.7% channels exist	Low actual engagement	Medium
Occupational Physician	72.9% availability	27.1% uncertain/unavailable	Medium

Table 8 consolidates key gaps identified across all analyses, prioritized by severity and impact on safety culture.

4.8 *Statistical Summary*

Gender and educational level significantly influence employees' perceptions of several safety culture indicators, requiring targeted interventions. The lack of significant differences by position and experience suggests a mature, consistently applied safety culture across organizational structure.

5. Discussion

The study reveals a paradoxical situation in hydrocarbon facility safety culture: strong institutional infrastructure with high employee awareness exists alongside significant participation gaps and demographic disparities. Over 90% of employees recognize safety policies and their implementation.

Gender emerges as the strongest predictor of safety perception differences. Female employees reported lower confidence in several safety indicators, which may indicate potential barriers to participation or inclusion in safety processes. This finding has important implications for organizational diversity strategies in high-risk industries.

Educational level's influence manifests counterintuitively: higher education correlates with more critical evaluation rather than greater confidence. Postgraduate-educated employees show lowest maintenance satisfaction (45.2%) while technically-educated employees show highest (95%+), suggesting that critical capacity, not ignorance, drives dissatisfaction—a finding that should inform how organizations interpret employee feedback.

The offshore-onshore performance gap, particularly in maintenance (90.2% vs. 53.3%), demonstrates how regulatory stringency and operational context influence safety outcomes. Offshore facilities' superior performance likely reflects both stricter maritime oversight and the critical nature of equipment reliability in isolated environments, suggesting context-adapted approaches are necessary.

Qualitative data from open responses emphasizes "communication," "participation," and "obstacles," indicating employees understand effective safety culture requirements but experience implementation barriers. Employee participation is widely recognized as a fundamental component of effective safety culture, as it strengthens engagement, communication and shared responsibility for risk prevention (Hudson, 2007; Antonsen, 2009). This awareness–implementation gap has been identified in previous research as a common challenge in the development of mature safety cultures (Antonsen, 2009; Hollnagel, 2014): the workforce is ready to engage more deeply if organizational barriers are addressed.

6. Conclusions and recommendations

This study demonstrates that hydrocarbon industry safety culture is mature in institutional terms—policies, procedures, and training infrastructure are well-established—but faces critical implementation gaps in participation, inclusion, and maintenance effectiveness.

6.1 *Key conclusions*

- Strong formal safety infrastructure exists with high employee awareness (>90% across most indicators)
- Gender significantly affects safety perception (H1 supported, $p<0.001$), requiring targeted inclusion initiatives
- Educational level influences critical evaluation capacity (H2 supported, $p=0.041$), with higher education correlating with more rigorous assessment
- Position and experience show patterns but not statistical differences (H3, H4 not supported), indicating consistent organizational culture
- Critical gaps exist in committee participation (31.6%), female inclusion (11.1% participation), and maintenance satisfaction (65.4%)
- Offshore facilities significantly outperform onshore in maintenance and compliance

Table 9. Hypothesis Testing Results

Hypothesis	Result	χ^2	p-value	Key Finding
H1: Gender affects perception	Supported	28.14	<0.001	Female employees show 20-30% lower confidence and participation
H2: Education affects trust	Supported	13.15	0.041	Higher education correlates with more critical assessment
H3: Position relates to views	Not supported	7.13	0.713	Pattern observed but not statistically significant
H4: Experience increases trust	Not supported	6.22	0.622	Indicates mature, consistent culture across experience levels

Table 9 summarizes hypothesis testing results, showing which factors significantly affect safety perception

6.2 *Recommendations*

- Address gender disparities through targeted inclusion programs, female mentorship in safety roles, and investigation of structural participation barriers
- Enhance maintenance systems with transparent tracking, employee feedback mechanisms, and visible responsiveness to reported issues
- Leverage educational diversity by recognizing that critical feedback reflects sophistication and should inform continuous improvement
- Adapt offshore best practices to onshore facilities, particularly maintenance protocols and regulatory compliance approaches
- Develop genuine two-way communication beyond channels to actual dialogue, ensuring employee input shapes safety policy evolution

6.3 *Future research*

Longitudinal studies tracking safety culture evolution after targeted interventions would provide valuable insights into change effectiveness. Qualitative research exploring gender participation barriers and maintenance effectiveness concerns could deepen understanding of implementation challenges. Comparative multi-company studies could identify industry-wide patterns versus organization-specific issues.

The study confirms that effective safety culture in high-risk environments requires more than institutional structures—it demands genuine inclusion, responsive systems, and organizational commitment to translating employee awareness into meaningful participation. For the hydrocarbon industry, these cultural elements are not merely desirable but essential for protecting workers and ensuring operational continuity.

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References

Konstantinos Mallas, N. (2025).Evaluation of Safety Culture Through Field Research in a Hydrocarbon Exploration and Exploitation Company, Master Thesis, Democritus University of Thrace

Reason, J. (1997). Managing the risks of organizational accidents. Ashgate Publishing.

Hudson, P. (2007). Implementing a safety culture in a major multi-national. Safety Science

Guldenmund, F. W. (2000). The nature of safety culture: A review of theory and research. Safety Science

Antonsen, S. (2009). Safety culture: Theory, method and improvement. Ashgate Publishing

Schein, E. H. (2010). Organizational culture and leadership. Jossey-Bass

Cooper, D. (2000). Towards a model of safety culture. Safety Science

Flin, R., Mearns, K., O'Connor, P., & Bryden, R. (2000). Measuring safety climate: Identifying the common features. Safety Science, https://doi.org/10.1016/S0925-7535(00)00012-6

International Atomic Energy Agency (IAEA). (1991). Safety culture. Vienna: IAEA

Zohar, D. (1980). Safety climate in industrial organizations: Theoretical and applied implications. Journal of Applied Psychology

Patton, M. Q. (2002). Qualitative research and evaluation methods. Sage Publications

Hollnagel, E. (2014). Safety-I and Safety-II: The past and future of safety management. Ashgate Publishing